

First record of *Deroceras invadens* Reise, Hutchinson, Schunack & Schlitt, 2011 (Gastropoda: Pulmonata: Agriolimacidae) from the island of Newfoundland, Canada

Robert G. Forsyth

New Brunswick Museum, 277 Douglas Avenue, Saint John, New Brunswick, Canada E2K 1E5.
 E-mail: rforsyth@mollus.ca

ABSTRACT: The introduced European slug *Deroceras invadens* Reise, Hutchinson, Schunack & Schlitt, 2011 is here reported from St. John's, Newfoundland. This new record is the first from the island of Newfoundland, the Canadian province of Newfoundland and Labrador, and from Atlantic Canada. It is the first verified record for this species living outside of greenhouses in eastern Canada.

Deroceras invadens Reise, Hutchinson, Schunack & Schlitt, 2011 was recently described for a species of terrestrial slug that has previously been called *D. panormitanum* (Lessona & Pollonera, 1882) or *Agriolimax caruanae* (Pollonera, 1891). Neither of these names is applicable to the invasive species that presumably originated from the Mediterranean region but now has an almost worldwide distribution (Reise *et al.* 2006, 2011).

There are just a few species of *Deroceras* Rafinesque, 1820, in North America in addition to the invasive *D. invadens*. *Deroceras laeve* (Müller, 1774), which may include the enigmatic west coast species *D. hesperium* Pilsbry, 1944 (Wiktor 2000; Roth *et al.* 2013), is widespread and generally considered a native species, although there is speculation that some populations could be introduced (Grimm *et al.* 2010). *Deroceras reticulatum* (Müller, 1774) is unquestionably an introduction and is now very widespread (Grimm *et al.* 2010). Both *D. reticulatum* and *D. invadens* are agricultural pests (Baker 1999; Reise *et al.* 2005).

Among species of *Deroceras* in North America, *D. invadens* is most similar to *D. laeve* (Reise *et al.* 2006). Both are smaller and darker than *D. reticulatum* and without the firmer body, thicker skin, and sticky, milky white mucus when irritated (Grimm *et al.* 2010). Reise *et al.* (2006) noted that some North American morphs of *D. laeve* are not separable by external appearance from *D. invadens*. *Deroceras invadens* is distinguished from *D. laeve* by morphological differences of the distal reproductive system (*sensu* Reise 2007), that is, of the penis and associated structures. The penis of *D. invadens* is strongly and equally bilobed. Between the lobes of the penis, there is a cluster of usually 4–6 finger-like glands (Forsyth 2004; Grimm *et al.* 2010; Reise *et al.* 2011) (Figure 1). Partial or total loss of the male reproductive organs is common for *D. laeve*, but when a penis is present, it is a long, somewhat contorted structure with a twisted terminal gland (Pilsbry 1948; Wiktor 2000). There is no cluster of finger-like glands.

On 6 September 2012, 8 specimens of *Deroceras invadens* were collected by R. Forsyth and T. Forsyth

from Masonic Terrace, St. John's, Newfoundland, Canada (47°33'56.4" N, 052°42'26.4" W; datum WGS84; Figure 2). Specimens were collected from under boards on bare earth adjacent to a garden within the city of St. John's. Specimens were deposited in the New Brunswick Museum mollusc collection (NBM 008860, 8 specimens). Identification of *D. invadens* was confirmed by Dr. Heike Reise (Senckenberg Museum für Naturkunde Görlitz). Other species of molluscs found were: *Deroceras reticulatum* (Müller, 1774), *Cepaea nemoralis* (Linnaeus, 1758), and *Oxychilus* sp. This is one of the Newfoundland sites reported by McAlpine *et al.* (2009) for *Arianta arbustorum* (Linnaeus, 1758).

At the time of collection, eight *Deroceras* slugs were suspected to be *D. invadens*, based on the habitat type. Animals were grey-brown, watery, thin-skinned, and not confidently separable from *D. laeve* (a species not found at the site). Later, dissections revealed the strongly bilobed penis and cluster of glands of this species, confirming the identity as *D. invadens* (Figure 1).

Deroceras invadens is now widely distributed to many places worldwide (Reise *et al.* 2006, 2010) and has been

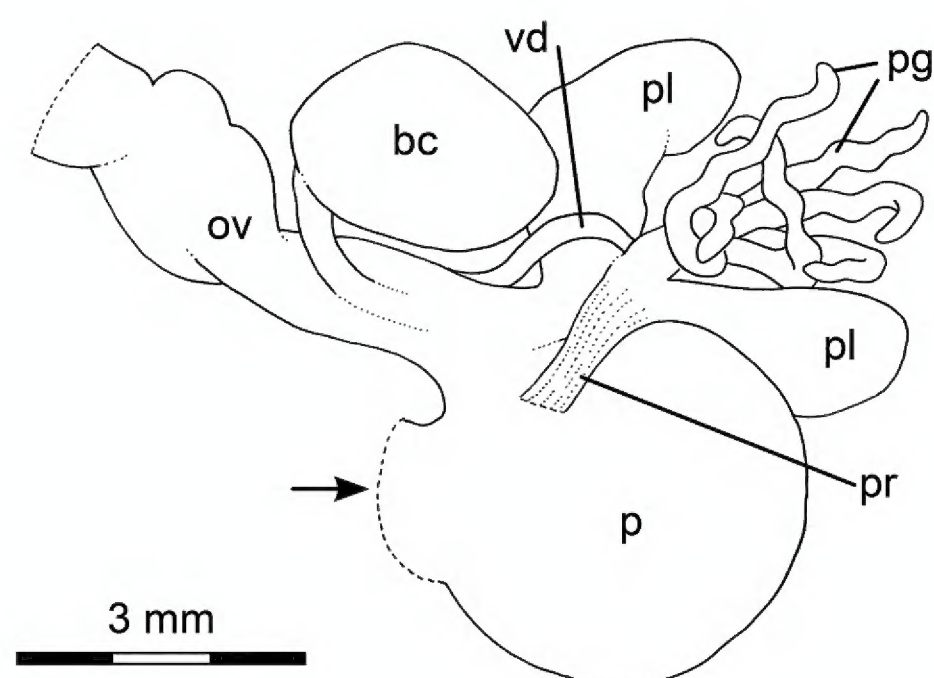


FIGURE 1. Distal genitalia of *Deroceras invadens* from St. John's, Newfoundland (NBM 008860). Abbreviations: bc, bursa copulatrix; ov, oviduct; p, penis; pg, penial glands; pl, lobe of penis; pr, penial retractor; vd, vas deferens. The arrow indicates that part nearest the genital pore (opening in the body wall).

found three or possibly four Canadian provinces (Figure 2). Under the names *Deroceras panormitanum* or *D. caruanae*, *D. invadens* has been known in North America for at least seven decades, having been first noticed in California in 1940 (Pilsbry 1948). In western North America, it is now rather well known from southern British Columbia to California (Grimm *et al.* 2010; Burke 2013), as well as Colorado (Reise *et al.* 2006). However, aside from a few reports from greenhouses, it was unknown from out-of-doors in eastern North America until recently found in Washington, D.C. (Reise *et al.* 2006). The first eastern North American and first Canadian records of this species was by Chichester and Getz (1969) who recorded it from two greenhouses in Montreal and Sherbrooke, Quebec. No other well-documented records exist for eastern Canada. Although Grimm *et al.* (2010) wrote that the species was found in Kingston, Ontario, they were unable to provide further data and in the absence of specimens could not verify the identification.

The present report of *Deroceras invadens* from St. John's, Newfoundland, is a new record for the province of Newfoundland and Labrador, the first from Atlantic Canada,

and the first verified record from outside of greenhouses in eastern Canada. The closest previously reported locality for *D. invadens* is the decades-old greenhouse record from Sherbrooke, Quebec (Chichester and Getz 1969).

Deroceras invadens lives in synanthropic habitats, along roadsides and in gardens, farms, nurseries and greenhouses and other disturbed and unkempt sites in cities and suburbs (Kerney 1999; Forsyth 2004; Reise *et al.* 2006, 2011; Burke 2013). Its presence in North America is probably under-recorded, and Reise *et al.* (2006) suggested that it is more widespread east of the Continental Divide than currently known. This species has probably been under-reported because of a general lack of interest in the slug fauna of cities and other disturbed habitats, as well as the great similarity to *D. laeve* that necessitates dissections to confirm identity. As noted by Reise *et al.* (2006), there is a need to record introduced terrestrial molluscs in North America and provide a baseline for future studies on these species' spread. It is anticipated that more searches in Newfoundland and elsewhere in eastern Canada may yield additional sites.

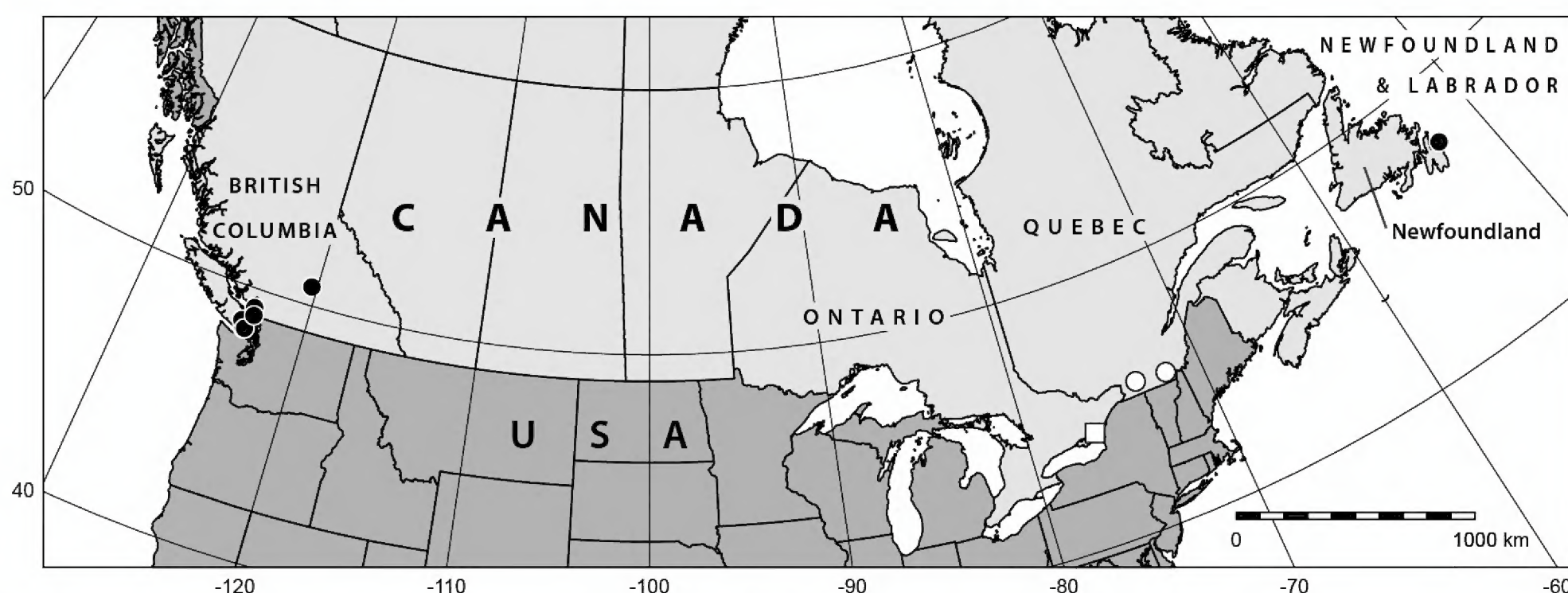


FIGURE 2. Known distribution of *Deroceras invadens* in Canada. Confirmed records (black circles): St. John's, Newfoundland (new record) and British Columbia (unpublished data; H. Reise and J.M.C. Hutchinson personal communication); multiple sites may be represented by a single symbol). Unconfirmed record (white square): Kingston, Ontario (Grimm *et al.* 2010). Greenhouse records (white circles): Montreal and Sherbrooke, Quebec (Chichester and Getz 1969).

ACKNOWLEDGMENTS: I thank Tammy Forsyth, who helped with the collection of the slugs, and Heike Reise (Senckenberg Museum für Naturkunde Görlitz, Germany) who assisted with the dissections and confirmed the identifications.

LITERATURE CITED

- Barker, G.M. 1999. Naturalised terrestrial Stylommatophora (Mollusca: Gastropoda). *Fauna of New Zealand* 48. Lincoln, New Zealand: Manaaki Whenua Press. 254 pp.
- Burke, T.E. 2013. *Land Snails and Slugs of the Pacific Northwest*. Corvallis, Oregon: Oregon State University Press. 344 pp.
- Chichester, L.F. and L.L. Getz. 1969. The zoogeography and ecology of arionid and limacid slugs introduced into northeastern North America. *Malacologia* 7(2-3): 313-346.
- Forsyth, R.G. 2004. *Land Snails of British Columbia*. Royal BC Museum Handbook. Victoria: Royal British Columbia Museum. 188 pp.
- Grimm, F.W., R.G. Forsyth, F.W. Schueler and A. Karstad. "2009" [2010]. *Identifying Land Snails and Slugs in Canada: Introduced Species and Native Genera*. Ottawa: Canadian Food Inspection Agency. iv + 168 pp.
- Kerney, M.P. 1999. *Atlas of the Land and Freshwater Molluscs of Britain and Ireland*. Colchester, England: Harley Books. 264 pp.
- McAlpine, D.F., F. Schueler, J.E. Maunder, R.G. Noseworthy and M.C. Sollows. 2009. Establishment and persistence of the copse snail, *Arianta arbustorum* (Linnaeus, 1758) (Gastropoda: Helicidae) in Canada. *The Nautilus* 123(1): 14-18.
- Pilsbry, H.A. 1948. Land Mollusca of North America (north of Mexico). Volume 2, Part 2. *The Academy of Natural Sciences of Philadelphia, Monographs* 3: xlvii pp. + 521-1113.
- Reise, H. 2007. A review of mating behavior in slugs of the genus *Deroceras* (Pulmonata: Agriolimacidae). *American Malacological Bulletin* 23(1/2): 137-156.
- Reise, H., J.M.C. Hutchinson and D.G. Robinson. 2006. Two introduced pest slugs: *Tandonia budapestensis* new to the Americas, and *Deroceras panormitanum* new to the eastern USA. *The Veliger* 48(2): 110-115.
- Reise, H., J.M.C. Hutchinson, S. Schunack and B. Schlitt. 2011. *Deroceras panormitanum* and congeners from Malta and Sicily, with a redescription of the widespread pest slug as *Deroceras invadens* n. sp. *Folia Malacologica* 19(4): 201-223.
- Roth, B., R. Jadin and R. Guralnick. 2013. The taxonomic status of *Deroceras hesperium* Pilsbry, 1944 (Gastropoda: Agriolimacidae), a species of conservation concern in Oregon, USA. *Zootaxa* 3691(4): 453-460.
- Wiktor, A. 2000. Agriolimacidae (Gastropoda: Pulmonata) — a systematic monograph. *Annales Zoologici* (Museum and Institute of Zoology, Polish Academy of Sciences) 49(3): 347-590.

RECEIVED: August 2013

ACCEPTED: December 2013

PUBLISHED ONLINE: February 2014

EDITORIAL RESPONSIBILITY: Luis Ernesto Arruda Bezerra